677

INSTRUCTION MANUAL

MODEL 7060

VCF/SWEEP GENERATOR

SN/5815 and up

DEPT. OF COMMUNICATION
CRC - SHIRLEY BAY
INSTRUMENT SECTION

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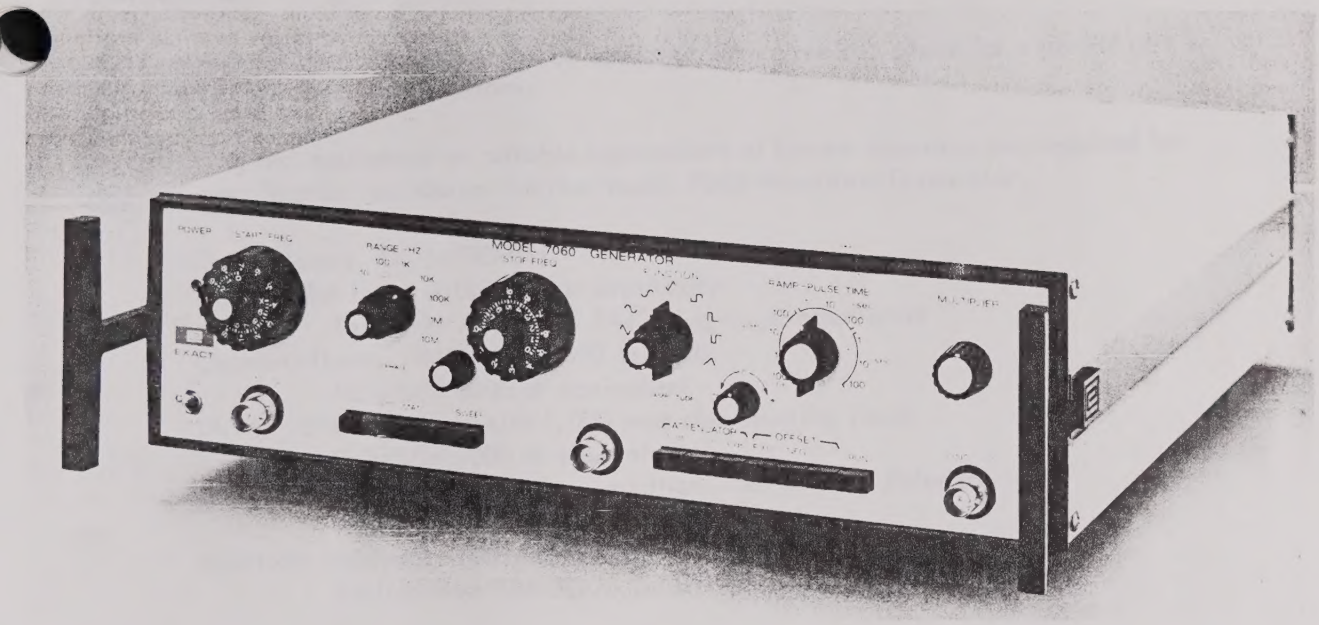
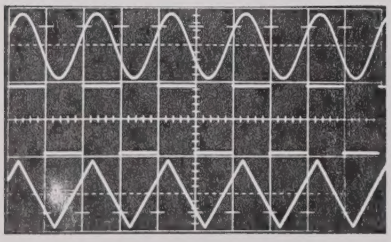
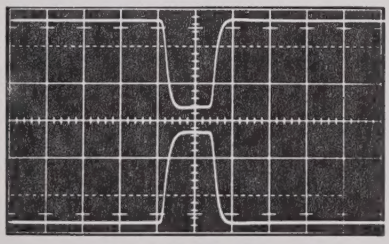


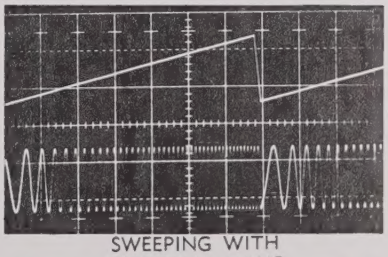
- 0.0001Hz TO 11MHz
- SWEEP GENERATOR (1000:1 RANGE)
- PULSE GENERATOR VARIABLE WIDTH AND REPETITION RATES
- TONE BURST GENERATOR
- 80 db ATTENUATION IN 10 db STEPS AND 20 db. VAR.
- VCO, VOLTAGE CONTROLLED OFFSET
- V:f (VOLTAGE PROPORTIONAL TO FREQUENCY) OUTPUT
- VARIABLE PHASE, START/STOP
- KELVIN VARLEY DIVIDER FREQUENCY AND STOP FREQUENCY CONTROLS
- SEARCH MODE FOR MANUALLY SWEEPING OVER THREE DECADES
- FLOATING OUTPUT
- ±15V OF DC OFFSET
- 50Ω OUTPUT FOR PULSE APPLICATIONS
- 30V P-P OPEN CIRCUIT, 15V P-P INTO 50Ω
- VCF INPUT FOR EXTERNAL FREQ. CONTROL



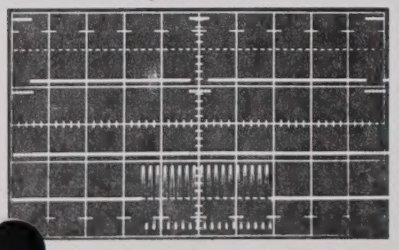
SINE SQUARE TRIANGLE



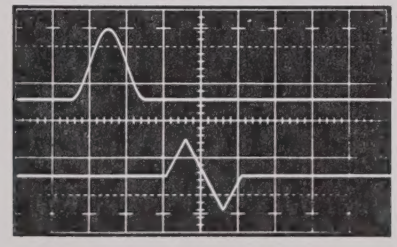
CLEAN HIGH FREQ. PULSES



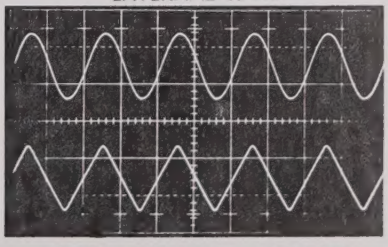
SWEEPING WITH EXTERNAL RAMP



PULSE AND BURST MODES



SINE² PULSE-SINGLE SHOT TRIANGLE



10MHz SINE AND TRIANGLE

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VERIFICATION OF SPECIFICATIONS

It is recommended that the instrument be operated with covers in place for a period of 1 hr. before verification of specifications.

The following test equipment or suitable equivalents of known accuracy are required for complete specification validation for the Model 7060 Waveform Generator.

Oscilloscope, DC to 90MHz
Differential Input with 5mv/cm sensitivity
Tektronix 7704 with 7A13 Plug-in or equivalent
Counter-Timer, 11MHz to 10,000 seconds
Fairchild 8200 or equivalent
DVM, .01% accuracy with 1,000 meg ohm floating input
Fairchild 7000 or equivalent
Harmonic Distortion Analyzer, less than .1% residual distortion
Hewlett-Packard 333 or equivalent
Spectrum Analyzer, 1MHz to 300MHz
Nelson Ross PSA 311 in Tektronix 544 frame or equivalent

Preset all the front panel controls as follows:

START FREQUENCY - 1.0
RANGE -1K
FUNCTION - square
AMPLITUDE - mid range
D.C. OFFSET - mid range
ATTENUATOR - All sections deactivated
RUN - activated
PHASE - mid range
GATE - deactivated
INT. - deactivated
SWEEP - Deactivated
GATE/TRIGGER LEVEL - mid range
RAMP-PULSE-WIDTH - 1 msec
VARIABLE - Cal.
RAMP RUN - deactivated

FREQUENCY ACCURACY: To measure the frequency accurately all frequency measurements below 1 kilohertz are expressed in period time and all above in hertz. With the counter connected to main output:

Mult. | Range	Actual Setting	Accuracy	Generator should be within
1.0 X .01	.01Hz	±(2% of setting + 2% of Range)	104 Sec. to 96 Sec.
.10 X .01	.001Hz	"	1220 " to 780 "
1.0 X .1	.1Hz	±(1% of setting + 1% of Range)	10.2 " to 9.8 "
.10 X .1	.01Hz	"	111 " to 89 "
1.0 X 1	1.0Hz	"	1.02 " to .98 "
.10 X 1	.10Hz	"	11.1 " to 8.90 "
1.0 X 10	10Hz	"	.102 " to .098 "
.10 X 10	1.0Hz	"	1.11 " to .890 "
1.0 X 100	100Hz	"	10.2ms to 9.80 ms
.10 X 100	10Hz	"	111 ms to 89.0 ms
1.0 X 1K	1KHz	"	1.02 ms to .980 ms
.10 X 1K	100Hz	"	11.1 ms to 8.90 ms
1.0 X 10K	10KHz	"	9.80KHz to 10.2KHz
.10 X 10K	1KHz	"	.890KHz to 1.11KHz
1.0 X 100K	100KHz	"	98.0KHz to 102KHz
.10 X 100K	10KHz	"	8.90KHz to 11.1KHz
1.0 X 1M	1.0MHz	"	.980MHz to 1.02MHz
.10 X 1M	100KHz	"	89.0KHz to 111KHz
1.0 X 10M	10MHz	±(2% of Range + 2% of setting)	9.60MHz to 10.4MHz
.10 X 10M	1MHz	"	.780MHz to 1.22MHz

SINE DISTORTION: Return the Function Selector to Sine Wave and also check to see that generator frequency is set for 1 kilohertz. Amplitude Control should be set for mid range.

1. Connect Distortion Analyzer to the Output Connector terminated into 50Ω. Measure the sine distortion of less than .5% typically .2%.

2. Set the Range to 100K. Measure Sine distortion of less than .5%.

3. Set Range to 10MHz. Connect the Spectrum Analyzer to main output jack and measure the harmonic content. Observe no harmonics less than 30 db down.

SINE FREQUENCY RESPONSE: Set the Range to 10K and connect the oscilloscope to the Output connector.

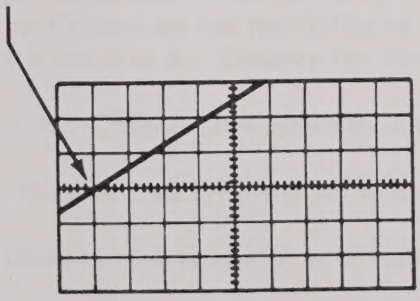
1. Observe sine wave amplitude.
2. Set Range to 100K. Observe sine amplitude drop less than .1 db.
3. Set Range to 10MHz. Observe sine amplitude drop less than 2 db.

SQUARE WAVEFORM: Set Function Switch to Square. Set Amplitude Control for an output voltage of 10V peak to peak or less into 50Ω. Any voltage greater than this value could yeild a rise time that is slower due to the slewing rate limitations.

1. Observe the rise and fall time to be less than or equal to 20 nanoseconds.
2. Observe that the overshoot and ringing are less than 5% of maximum peak to peak amplitude.

TRIANGLE LINEARITY: Set Range Switch to 1K. Set the Function Selector to Triangle. Monitor the Output Connector with the oscilloscope.

1. Adjust the oscilloscope to obtain 1/2 cycle of the triangular waveform across the full horizontal grid on the oscilloscope CRT.
2. Reset the Differential Plug-in to a sensitivity of 20 millivolts per centimeter.
3. Adjust the comparison voltage until the slope of the triangle waveform intersects the mid-scale horizontal grid line at the second major mark as shown below.



TRIANGLE LINEARITY: (Continued)

4. Record reference voltage using the DVM accurate to I millivolt.

5. Adjust the comparison voltage until slope of triangle intersects next major horizontal grid mark.

6. Record accurately the new reference voltage.

7. Repeat to obtain as many points as desired.

8. Calculate linearity and observe linearity is within specifications.

9. Beware of oscilloscope inadequacies above 10KHz.

FREQUENCY STABILITY: Connect Frequency Counter to main output terminated into 50Ω. Measure frequency accurately. Note the frequency reading. Wait 10 minutes. Measure frequency again and note that frequency change should be less than .05%. Wait 24 hrs. Measure frequency again and note reading remains within .25%.

AMPLITUDE STABILITY: Set amplitude control to maximum. Set DC Offset to Off. Function to Triangle. Connect output of generator to oscilloscope and measure the output, both positive and negative peaks with a 20 millivolt per centimeter sensitivity on the oscilloscope. Measure accurately and record the value of the positive and negative peaks that the triangle produced at the output. Wait 10 minutes and measure positive and negative peaks again and observe the amplitude changes less than 15 millivolts. Wait 24 hrs., measure the positive and negative peaks again and observe the amplitude change is less than 75 millivolts. Note that when measuring the amplitude using the peaks the maximum peak to peak value is the addition of the two peak values.

TIME SYMMETRY: Connect the counter timer to the Sync Output Connector on the front panel. Set the Range to 10K and set the Multiplier to 1.0. Set the Counter Timer to read time interval A to B and B to A. Observe the time symmetry error is less than 1%.

1. Set Range switch to 1K. Observe time symmetry error less than 1%.

2. Set Range to 100. Observe time symmetry error less than 1%.

3. Set Range to 10. Observe time symmetry error less than 1%.

4. Set Range to 1. Observe time symmetry error less than 1%.

RAMP FREQUENCY ACCURACY:

Deactivate the main generator Run button and activate the Ramp Run button.
Select Ramp waveform on the Function Selector.
Verify variable Ramp-Pulse Width control is in the Calibrated position.
Connect the counter timer to the Ramp Sync Output on the rear panel and set it to read time between the rising edge of the pulse and the falling edge of the pulse.

Ranges should read as follows:

Ramp-Pulse Width	Reading should be within
100 sec.	95 - 105 sec.
10 sec.	9.5 - 10.5 sec.
1 sec.	.95 - 1.05 sec.
100 msec.	95 - 105 msec.
10 msec.	9.5 - 10.5 msec.
1 msec.	.95 - 1.05 msec.
100 µsec.	95 - 105 µsec.
10 µsec.	9.5 - 10.5 µsec.
1 µsec.	.95 - 1.05 µsec.
100 nsec.	95 - 105 nsec.

2.1.0 FRONT PANEL FAMILIARITY (Figure 2.1.1)

1. Power On/Off Switch - turns on input power to instrument.

2. Pilot Lamp - indicates input power is On.

3. Function selector - selects waveform to appear at Output connector.

4. Amplitude Control - Allows 20 db continuously variable voltage at Output conector.

5. D.C. Offset - Allows continuously variable D.C. level of waveforms at the Output connector when activated by Offset Variable pushbutton.

6. Sync Out - Provides square waveform for synchronizing other equipment to Sine Square Triangle or Pulse waveforms.

7. Offset Variable - Activates the Variable D.C. offset control.

8. Offset Fixed - Selects unipolar waveforms at the Output connector. Activating this control maintains the most negative excursion of the waveform at zero volts (within instrument tolerance) and allows continuously variable control of the amplitude. (For Sine Square Triangle only).

9. Offset Negative - When activated at the same time as Offset Fixed reverses the action so that the most positive excursion is at zero volts (within tolerance) (Note 8 and 9 above for Offset Variable deactivated).

10. Attenuator 10 db, 20 db, 30 db - Allows fixed step attenuation of waveforms appearing at the Output connector. Any combination of the three controls can be activated providing a maximum additive step attenuation of 60 db.

11. Output connector - Provides 50 ohm output impedance for waveforms selected by the function selector.

2.1.0 FRONT PANEL FAMILIARITY

12. Start Frequency - This control allows vernier setting of the start frequency or the generator frequency from which the generator can be swept to another frequency by providing an outer dial with steps of 10% of its range and an S position which places the generator in the search mode plus providing a smaller variable adjustment that cover the range between each of the fixed steps of the outer dial.

13. Range - Repetition Rate - Hertz - This control selects the operating frequency range of the sine, triangular and square waveforms and it also selects the operating range for the repetion rate of the pulse waveforms.

14. Stop Frequency - This control allows calibrated fixed step adjustment of the end frequency that the generator will operate during a frequency sweep. The outer dial provides calibrated fixed steps with a 10% of range step and an inner dial with a vernier or continuously variable adjustment for operating between fixed steps of the outer dial.

15. Ramp-Pulse Width - This control selects the operating range for controlling the duration of one ramp waveform or the duration one pulse.

16. Variable - This control provides a continuously variable adjustment of the ramp or pulse width over an operating range of 10 to 1.

17. Gate/Trig.Level - This continuously variable control allows selection of the voltage at which the trigger input circuitry will be activated providing gated or triggered mode of operation.

18. Run - This control when activated provides a free running waveform as selected by the function selector.

19. Gate - This control when activated provides an external means of controlling when the generator runs in a free running mode or stops.When both the run and the gate controls are deactivated then the generator will provide a single cycle of a waveform for each external or manual command signal that is applied.

20. Manual - This control provides a manual means of gating or triggering the generated waveform.

21. Phase - Allows a continuously variable gate or trigger starting point for the sine and triangular waveforms.

22. Trigger Input - Accepts the input signals necessary for gated or triggered mode of operation.

23. Internal - This control when activated utilizes the ramp generator portion of this instrument to internally gate or trigger the sine, square and triangular waveform generator.

24. Sweep - This control, when activated, allows the ramp generator to vary the frequency of the main triangular, square and sine waveform generator at the rate selected by the Ramp-Pulse Width controls.

2.1.0 FRONT PANEL FAMILIARITY (Figure 2.1.1)

25. Run - This control, when activated, provides a free running ramp waveform for use in the sweep mode of operation or for generation of the ramp output waveform. When this control is not activated the ramp or sweep waveforms can be triggered externally.

2.2.0 REAR PANEL FAMILIARITY (Figure 2.2.0)

1. Line Voltage Selector - Allows instrument operation at 117 or 220 volts AC.
2. Fuse Holder - Allows easy replacement in the event of fuse failure.
3. Line Cord - Accepts input power for the instrument.
4. Circuit Common Connection - Allows floating circuit common operation of instrument.
5. Chassis Ground Connection - Provides for grounding of circuit commons.
6. Power Transistor - Minus 15 volt supply Q175.
7. Power Transistor - Plus 15 volt supply Q135.
8. Power Transistor - Plus 24 volt supply Q125.
9. Power Transistor - Minus 24 volt supply Q145.
10. Power Transistor - Plus 3.2/minus 2.0 supply Q105.
11. Sync Input Connector - Accepts an input signal for synchronizing generator frequency.
12. VCF Input Connector - Accepts wide band AC or DC input for analog programming of generator frequency.

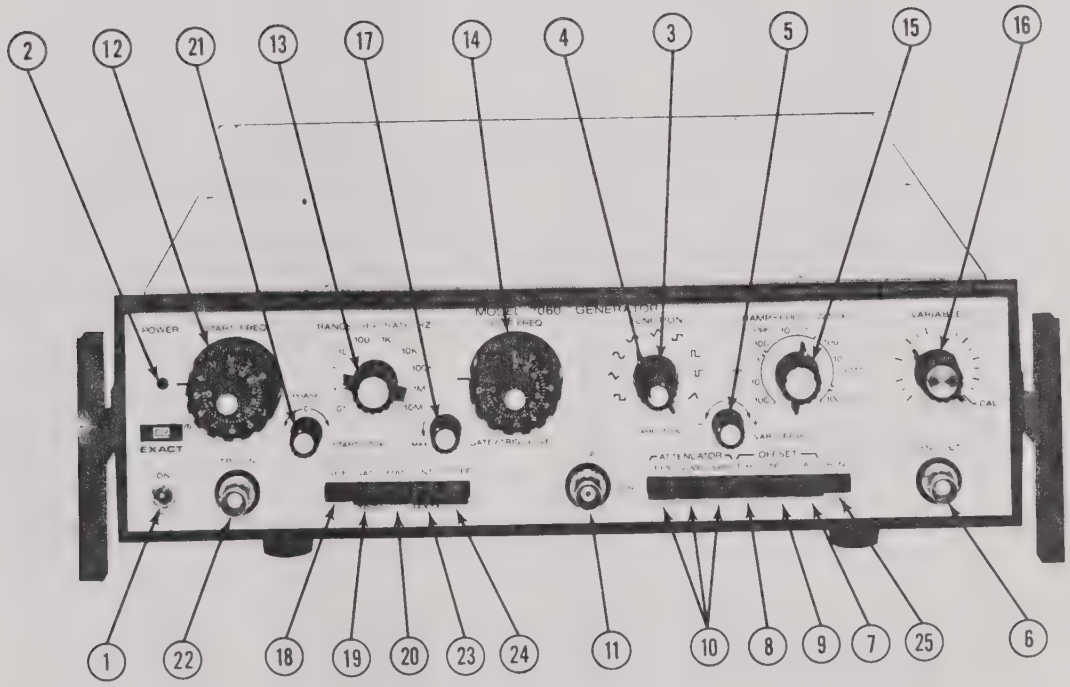


FIGURE 2.1.1 MODEL 7060
FRONT PANEL FAMILIARITY ©

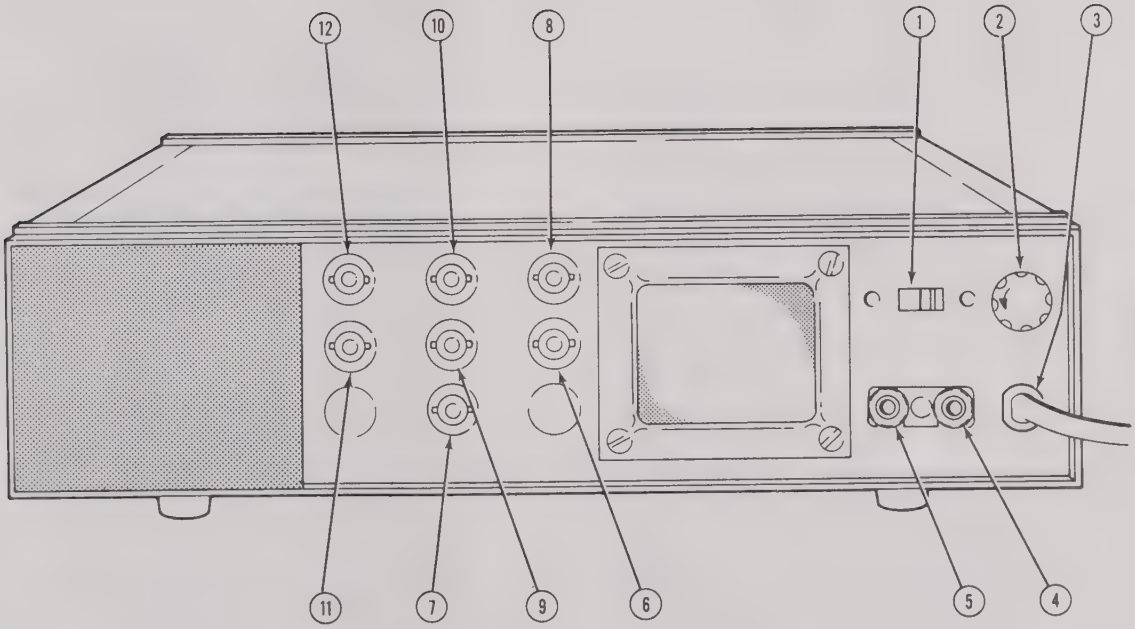


FIGURE 2.2.0 REAR PANEL FAMILIARITY ⓒ Ⓔ

2.3.0 FIRST TIME OPERATION

NOTE: Before applying power to the instrument the input power line switch must be in the proper position corresponding to the line voltage source which will be applied. The instrument is supplied with the proper fuse for 117 volt operation. If the unit is to be operated from 220 volts AC, place the line switch located on the rear panel to the 220 volt position and change the fuse as indicated by the fuse data silk screened on the rear panel.

NOTE: It is recommended that the rear panel chassis ground and circuit ground connections be connected together with the grounding strap provided unless it is necessary to float the instrument ground.

1. Plug the instrument into source of 117 volt 50 to 400 cycle AC power and turn on Power switch. Preset all front panel controls as follows:

START FREQUENCY	to 1.0
RANGE-REP. RATE	to 1K
STOP FREQUENCY	to 1.0
FUNCTION	to Triangle
RAMP PULSE WIDTH	to 100 microseconds
VARIABLE	to Cal
AMPLITUDE	to maximum
PHASE	to mid range
RUN	activated or depressed
GATE	deactivated
MANUAL	deactivated
INTERNAL	deactivated
SWEEP	deactivated
GATE/TRIGGER LEVEL	maximum clockwise
ATTENUATOR	all three buttons deactivated
OFFSET	all three buttons deactivated
VARIABLE OFFSET	to mid range
RAMP RUN	deactivated or in trigger mode

2.3.0 FIRST TIME OPERATION

2. WAVEFORMS
   Connect generator outputs through 50Ω coaxial cable into 50Ω coaxial load and the vertical input of a suitable oscilloscope. The instrument should be providing a 1 kilohertz triangular waveform at approximately 15 volts peak to peak amplitude.
3. FUNCTION
   Switch the function selector through its Sine, Triangle and Square waveforms and observe the change in wave shape on the oscilloscope. Return the function selector to Sine wave.
4. AMPLITUDE
   Rotate the amplitude control through its range and note that there is a continuously variable control of 20db on the output amplitude of the generator. Return this amplitude control to mid range.
5. FIXED OFFSET
   Depress the fixed offset button and note that the waveform reduces in amplitude on the oscilloscope presentation and also note that its most negative excursion is 0 volts. Again rotate the amplitude control through its range and note that the most negative excursion under any condition is 0 volts for the selected waveform. Next depress the negative offset button while leaving the fixed offset button depressed. Note that the waveforms most positive excursion now is 0 volts and as you rotate the variable amplitude control this condition remains the same. Note that both fixed and negative offset buttons must be depressed to activate this mode. Deactivate both the fixed and negative offset buttons and return the variable amplitude control to mid range.
6. VARIABLE OFFSET
   Depress the variable offset button and rotate the DC offset control and note that the DC level of the waveform is now adjustable. Note maximum output signal levels must not be exceeded when utilizing both maximum amplitude and any amount of DC offset. Deactivate the variable offset button and return the amplitude control to mid range.
7. EXTERNAL OFFSET
   Using a low impedance variable voltage source apply a small voltage to the external offset input and note that for each positive volt of input there is a matching negative volt of output from the generator. Again noting that maximum output cannot exceed the maximum output level of the generator. Also note that for each negative volt of external offset applied there is a positive volt on the output thus verifying the relationship as a 1 to 1 inverting configuration. Remove the external supply and return the variable amplitude control to maximum clockwise.
8. ATTENUATOR
   Depress the 10db attenuator and note that the output amplitude reduces to approximately 1/3 of its original level. Deactivate the 10db attenuator and then depress the 20db attenuator and note that the output amplitude drops to approximately 1/10th its original level. Deactivate the 20db attenuator and depress the 30db attenuator and note that the output amplitude is reduced to approximately 1/30th the original amplitude. Leaving the 30db attenuator activated depress the 10db attenuator and note that the overall attenuation then adds to be 40db and so forth and so on until a maximum of 60db attenuation is attainable through the push button attenuation. Note also that these attenuators attenuate the DC offset in the same porportion as the output amplitude. Return all attenuator buttons to a deactivated state.

2.3.0 FIRST TIME OPERATION

9. EXTERNAL SYNC

Connect an external oscillator signal of approximately 5 volts peak to peak and approximately 1 kilohertz in frequency to the sync input connector. Rotate the Start Frequency Dial until the generator frequency is within 1% of the applied synchronizing frequency and the two generator should phase lock or synchronize together. This can be demonstrated by connecting the external synchronizing input of the oscilloscope to the external 1 kilohertz synchronizing source. As the waveform generator then becomes synchronized with the external source the waveform as it appears on the oscilloscope will not move and will be stable. Disconnect the external synchronizing signal and connect the oscilloscope external synchronizing input to the waveform generator sync output connector. Note that the oscilloscope again can be synchronized using the sync output connector from the generator.

10. MULTIPLIER AND RANGE DIALS

Return the Start Frequency Dial to a setting of 1.0. Note that the frequency then is 1.0 times the range setting of the 1K or 1 kilohertz. Turn the inner dial of the Start Frequency Dial to X and note that the generator frequency then has increased to 10% over the 1 kilohertz or 1.1 kilohertz. Return the inner dial to 0. Turn the outer dial to .9 and note then that the generator frequency is .9 times 1K or 900 hertz. Turn the inner dial up from 0 to X and note then that the frequency of the generator can be changed from 900 to 910, 920, 930 etc. on up to 1000 hertz again. Return the inner dial to 0. Turn the outer dial through each of its steps and note that the generator frequency can be continuously varied from an overrange of 1.1 down to .1 times the range frequency setting or in other words from 100 hertz to 1 kilohertz. Rotate the outer dial to the position marked S and note then that the inner dial will cause the generator frequency to be varied from a maximum of the 10% overrange or 1.1 times 1 kilohertz down to 1/1000th of the 1 kilohertz or approximately 1 hertz. This is the search mode of operation providing the continuously variable 1000 to 1 range. Reset the inner dial to 0.

11. VCF

Connect an external DC voltage supply to the VCF input connector and note then that as the generator is at 1 hertz from the previous step above the generator frequency can be increased by applying the 0 to 5 volts to the VCF input connector. Rotate the Search Control to X and apply a negative 0 to 5 volts to the VCF input connector and note that the frequency can be reduced from 1.1 kilohertz down to the lower frequency of 1 hertz by applying negative 5 volts. Note that in no case should the generator frequency be increased beyond the 1.1 times the range setting nor should it be lowered below 1 hertz or 1/1000th of the range frequency setting. Return the Start Frequency Dial to 1.0.

12. RAMP FUNCTIONS

Rotate the Function Selection to Ramp Waveform and depress the ramp Run button. Note then that on the output there is a 100 microsecond length ramp waveform. Rotate the Ramp-Pulse Width selector to select the proper range of operating times as needed. Note also that the variable control provides continuously variable adjustment throughout 10 to 1 range of the ramp pulse width. Return Ramp-Pulse Width to 100 milliseconds and Variable to Cal.

13. RUN, GATE, TRIGGER and TONE BURST

Return the Function Selector to positive going sine wave and deactivate the main generator Run button. Connect an external oscillator signal of approximately 5 volts peak to peak and 100 hertz in frequency to the Trigger Input connector.

2.3.0 FIRST TIME OPERATION

At the output then there should be a single cycle sine wave available for each cycle of the incomming 100 hertz waveform. Rotate the Gate/Trigger Level control and note that the trip voltage at which the generator cycle starts is variable through rotation of the Gate/Trigger Level control. Depress the Gate button and note then that the generator will run continuously as long as the externally applied oscillator voltage is greater than the Gate/Trigger level. Note then that this burst width can be controlled by the Gate/Trigger level. Note also that the generator always completes its last cycle of operation after the Gate signal has been removed. Remove the external oscillator signal from the trigger input connector and note that the generator can be manually controlled by depressing the Manual button. By depressing this button in the gate mode note that the generator will be gated continually while the button is depressed. Also note that in the trigger mode where both the Run and Gate buttons are deactivated that for each time the manual button is depressed a single cycle of output waveform is obtained. Deactivate all three Run, Gate and Manual buttons and depress the button marked nternal. Note, now that there is a positive going sine wave from the output controlled by the Gate-Trigger Level control and the Ramp-Pulse Width controls. In this mode the Ramp-Pulse generator is being used to internally operate the Sine, Square and Triangular generator. Note that in the triggered mode of operation for the main generator that for each ramp or pulse cycle there is one sine, square, triangle waveform generated. By depressing the Gate button on the main generator the burst of cycles then available can be controlled by rotating the Gate/Trigger Level control. Deactivate the internal button and activate the Run button for the main generator. Return the Ramp-Pulse Width control to 100 microseconds.

14 PULSE GENERATION

Rotate the Function Selector to positive going pulse waveform. Note that the output waveform now obtained can be individually controlled in pulse width and repitition rate by the corresponding controls.

15 SWEEP

Return the Range-Rep Rate dial to 1K and return also the Ramp-Pulse Width control to 1 second, the Variable to Cal. Set the Start Frequency Dial to 0.1 and the Stop Frequency Dial should still be set to 1.0. Depress the Sweep button and the Ramp Run button. Note, now, that the output waveform is a sinewave that is starting at 100 hertz (the start frequency, times the Range-Rep rate) and sweeping up to a stop frequency of 1 kilohertz - that is, 1.0 times the Range-Rep rate of 1K. Note, now, that you have a continuously variable control of the frequency at which the sweep starts and a continuously variable control calibration for the frequency at which the sweep stops. Note, also, that as you set these dials that the start frequency may be set to a lower value than the stop frequency for starting at a low frequency and sweeping to a higher frequency. It is also possible to set the Start Frequency at a higher setting and the Stop Frequency at a lower setting and sweep from a higher to a lower frequency. Note that at the Ramp Sync Output connector there is a pulse coincident with the start of the Ramp that would provide synchronization of external equipment at the start of the sweep. Note, also, that if the Ramp-Run button is deactivated the ramp can be initiated by an external signal starting the sweep at the Ramp-Trigger Input Connector. Note, also, that at the V to F Output Connector there is a voltage available that is directly proportional to generator frequency. Also available is the ramp output waveform that provides a continuous monitoring of the ramp waveform generated within the instrument.

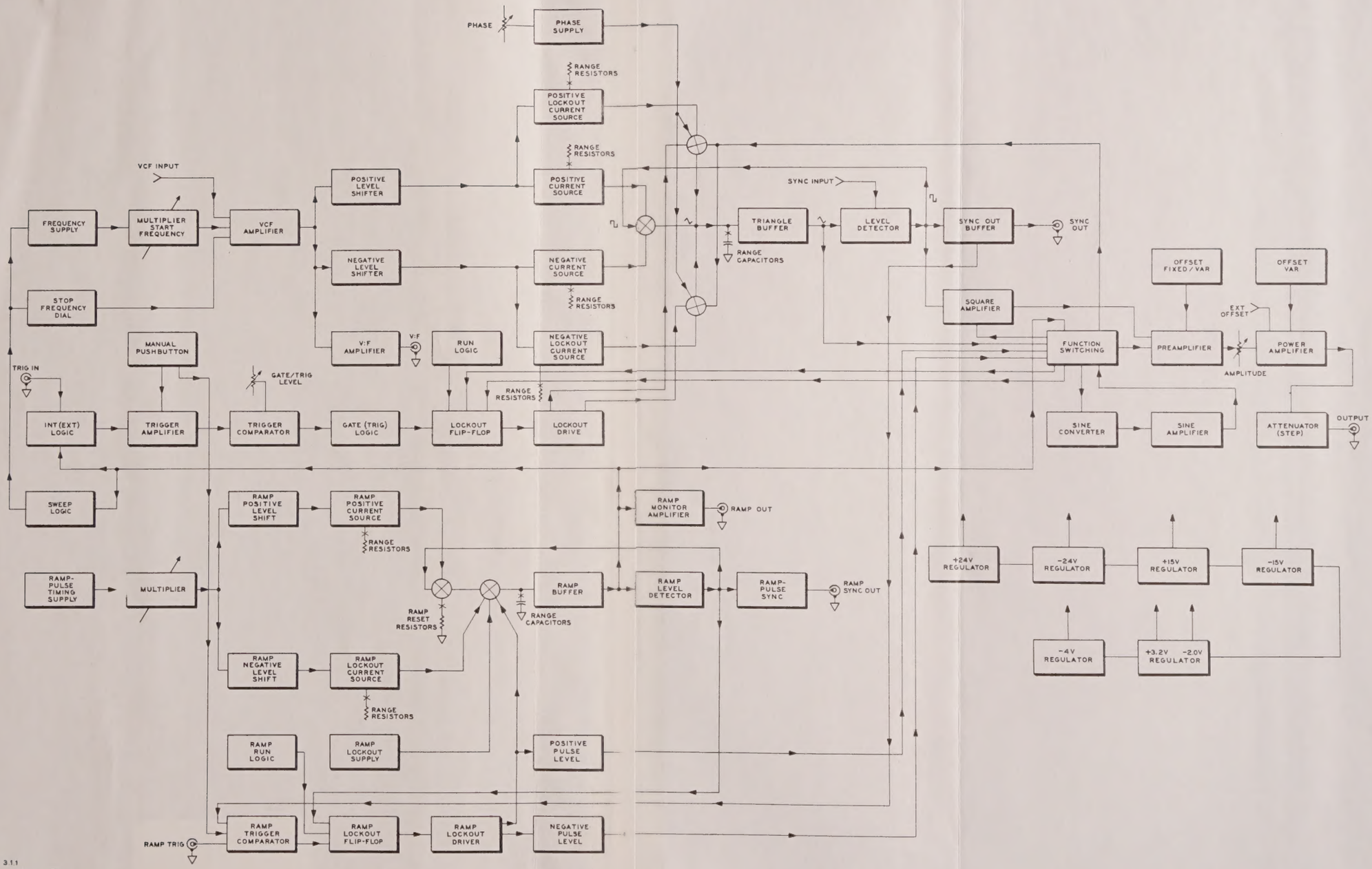


FIGURE 3.1.1
BLOCK DIAGRAM ©

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